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The Investment Performance of U.S. Equity Pension
Fund Managers: An Empirical Investigation

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WP #3360-91 EFA

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The Investment Performance of U.S. Equity Pension Fund Managers:
An Empirical Investigation

ABSTRACT

This paper presents an empirical examination of the selectivity and timing performance of a sample of U.S. equity pension fund managers. Regardless of the choice of benchmark portfolio or estimation model, the average selectivity measure is positive and the average timing measure is negative. However, selectivity does appear to be somewhat sensitive to the choice of a benchmark when managers are classified by investment style. Meta-analysis revealed some real variation around the mean values for each measure. The 80% probability intervals for selectivity revealed that the best managers produced substantial risk-adjusted excess returns. Consistent with previous studies of mutual fund performance, we also found a negative correlation between selectivity and timing.

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The Investment Performance of U.S. Equity Pension Fund Managers:

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Each year Pensions & Investments, a leading trade newspaper for the pension management industry, profiles the top 1000 public and private U.S. pension funds. At year-end 1990, these funds had total pension assets of \$1.876 trillion. Approximately \$750 billion (40 percent) was invested in equities. The Investment Company Institute estimates that \$250 billion was invested in open- and closed-end equity-oriented U.S. mutual funds at year-end 1990. This snapshot indicates a 3:1 ratio for pension equity investment versus mutual fund equity investment. Not only is the dollar difference large, but also the difference in the number of managers in each universe is large. The total number of pension fund managers is much larger than the number of mutual fund managers, by a ratio of approximately 10:1. Yet surprisingly little research has been done on the investment performance of U.S. equity pension fund managers. This paper begins to fill an important gap in the literature by providing empirical evidence on the investment performance of these managers.

The focus of this study is on equity pension fund managers who have been allocated funds by a pension plan sponsor. Brinson, Hood and Beebower (1986), Ippolito and Turner (1987), and Berkowitz, Finney and Logue (1988) examined the investment performance of a sample of large U.S. pension plans. Each plan may be composed of many fund managers in different asset categories with their own specific investment objectives and styles. To date, ours is the only study we know of which specifically examines the components of the investment performance of a sample of U.S. equity pension fund managers.

The two components we examine are security selection skill and market timing skill. Security selection involves the identification of individual securities which are under- or overvalued relative to the market in general. Within the specification of the Capital Asset Pricing Model (CAPM), the investment manager attempts to identify securities with expected returns which lie significantly off the security market line. The manager will then invest in those securities which offer an abnormally high risk premium. Market timing refers to forecasts of return on the market portfolio. If the manager believes he can forecast the market return, he will adjust his portfolio risk level accordingly.

According to the efficient market hypothesis, all active investment management activity is futile. The only rational investment choice for a plan sponsor is to invest in a passively managed market index. Hence, in an efficient market, plan sponsors would not rationally invest in (or pay active management fees for) an investment program which cannot outperform a market index. However, there exists a very large active pension fund management business in the United States. Our study will shed some light on the question of whether or not pension funds are behaving rationally to perpetuate this business. Our paper is organized as follows. Section I presents the models of selectivity and market timing used in this paper. Section II describes the data and methodology. Section III presents the empirical results. Section IV presents a meta-analysis of our results. Section V discusses the results. Section VI concludes our paper.

I. Models of Selectivity and Timing

It is important that portfolio managers be evaluated on both selection ability and market

timing skill. Accordingly it is necessary to model timing and selectivity simultaneously. Jensen (1968, 1969) formulated a return-generating model to measure performance of the managed portfolios. The model is:

$$R_{pt} = \alpha_p + \beta_p R_{mt} + u_{pt} \quad (1)$$

where R_{pt} is the excess (net of risk-free rate) return on the p th portfolio. R_{mt} is the excess (net of risk-free rate) return on the market portfolio, β_p measures the sensitivity of the portfolio to the market return and u_{pt} is a random error which has expected value of zero. α_p is a measure of security selection skill. This specification assumes that the risk level of the portfolio under consideration is stationary through time and ignores the market timing skill of the managers. Indeed, portfolio managers may shift the overall risk composition of their portfolio in anticipation of broad market price movements. Fama (1972) and Jensen (1972) addressed this issue and suggested a somewhat finer breakdown of performance.

Treynor and Mazuy (1966) added a quadratic term to equation (1) to test for market timing ability. They argued that if the manager can forecast market returns, he will hold a greater proportion of the market portfolio when the return on the market is high and a smaller proportion when the return on the market is low. Thus, the portfolio return will be a non-linear function of the market return as follows:

$$R_{pt} = \alpha_p + \beta_p R_{mt} + \gamma(R_{mt})^2 + \epsilon_{pt} \quad (2)$$

A positive value of γ would imply good market timing.

Jensen (1972) developed a similar model to detect selectivity and timing skill of managers. Jensen's measure of market timing performance calls for the fund manager to forecast the deviation of the market portfolio return from its consensus expected return. By

assuming that the forecasted return and the actual return on the market have a joint normal distribution, Jensen shows that, under this assumption, a market timer's forecasting ability can be measured by the correlation between the market timer's forecast and the realized return on the market. He concluded that, under the above structure, the separate contributions of selectivity and timing can not be identified unless, for each period, the manager's forecast and consensus expected return on the market portfolio, $E(R_m)$, are known.

Bhattacharya and Pfleiderer (1983) extended the work of Jensen (1972). By correcting an error made in Jensen (1972), they show that one can use a simple regression technique to obtain measures of timing and selection ability. Jensen assumes that the manager uses the unadjusted forecast of the market return in the timing decision. Bhattacharya and Pfleiderer assume that the manager adjusts forecasts to minimize the variance of the forecast error. They specify a relationship in terms of observable variables, which is similar to the Treynor and Mazuy model:

$$R_{pt} = \alpha_p + \Theta E(R_m)(1 - \Psi)R_{mt} + \Psi\Theta(R_{mt})^2 + \Theta\Psi\epsilon_t R_{mt} + u_{pt} \quad (3)$$

where

Θ = the fund manager's response to information,

Ψ = the coefficient of determination between the manager's forecast and the excess return on the market, and

ϵ_t = the error of the manager's forecast

This quadratic regression of R_{pt} on R_{mt} allows us to detect the existence of stock selection ability as revealed by α_p . The disturbance term in equation (3):

$$\omega_t = \Theta\Psi\epsilon_t R_{mt} + u_{pt} \quad (4)$$

contains the information needed to quantify the manager's timing ability. We can extract this information by regressing $(\omega_j)^2$ on $(R_{mt})^2$:

$$(\omega_j)^2 = \Theta^2 \Psi^2 (\sigma_e)^2 (R_{mt})^2 + \zeta_i, \quad (5)$$

where

$$\zeta_i = \Theta^2 \Psi^2 (R_{mt})^2 [(\epsilon_j)^2 - (\sigma_e)^2] + (u_{pj})^2 + 2\Theta \Psi R_{mt} \epsilon_i u_{pi}. \quad (6)$$

The proposed regression produces a consistent estimator of $\Theta^2 \Psi^2 \sigma^2 \epsilon$, where $(\sigma_e)^2$ is the variance of the manager's forecast error. Using the consistent estimator of $\Theta \Psi$, which we recover from equation (3), we obtain $(\sigma_e)^2$. This, coupled with knowledge about $(\sigma_\pi)^2$, the variance of excess return on the market, allows us to estimate $\Psi = (\sigma_\pi)^2 / [(\sigma_\pi)^2 + (\sigma_e)^2] = \rho^2$, where ρ is the correlation between the manager's forecast and excess return on the market. Finally, we calculate ρ which truly measures the quality of the manager's timing information.

The Bhattacharya and Pfleiderer model of equation (3) is a refinement of the Treynor and Mazuy model. It focuses on the coefficient of the squared excess market return as an indication of timing skill. It is the first model that analyzes the error term to identify a manager's forecasting skill. Such a refinement should make the model more powerful than previous ones. Further detail and econometric issues relating to the Bhattacharya and Pfleiderer model are discussed in Lee and Rahman (1990). In the empirical tests reported in Section III, we employed both the Treynor and Mazuy and the Bhattacharya and Pfleiderer models. This will allow us to examine the sensitivity of results to alternative model specifications.

There are other models in the literature that permit identification and separation of selectivity and timing skills of portfolio managers. These are models by Grinblatt and Titman (1989b), Henriksson and Merton (1981), and an alternative version of the Henriksson and

Merton model by Kon and Jen (1978, 1979). The Grinblatt and Titman model requires the observation of the historical sequence of portfolio weights for the manager. Unfortunately, data on portfolio weights are very costly and time-consuming and often not available. The Henriksson and Merton model provides no significant advantage over the Bhattacharya and Pfleiderer model. One weakness of the Henriksson and Merton model is that information is measured but there is no test of whether the information is being used correctly. The forecasters in this model are less sophisticated than those of the Bhattacharya and Pfleiderer model, where they do forecast how much better the superior investment will perform. Henriksson and Merton assume that managers have a coarse information structure in which dichotomous signals are only predictive of the sign of the excess return of the market relative to the risk-free rate. In their model, the probability of receiving an "up" or a "down" signal in no way depends upon how far the market will be "up" or "down."

II. Data and Methodology

The data for this study consist of monthly returns for the period January 1983 through December 1990 (96 months) for a sample of 71 U.S. equity pension fund managers. Returns are net of expenses and management fees. These managers invest exclusively in the U.S. equity market. The data were provided by the Frank Russell Company of Tacoma, Washington. Among other services, the Frank Russell Company evaluates the performance of the managers of a number of pension funds throughout the United States. The Frank Russell Company segregates equity managers into four basic investment styles on the basis of managers' portfolio characteristics. These are: (1) Earnings Growth, (2) Market-Oriented, (3) Price-Driven, and

(4) Small Capitalization. Our sample consists of 18 Earnings Growth, 19 Market-Oriented, 18 Price-Driven, and 16 Small Capitalization managers. Appendix I.A describes these four investment styles. Monthly observations for the Treasury bill rate was used as a proxy for the risk-free rate.

Our study uses several alternative equity benchmark portfolios. Two of these are the S&P 500 Index and the Russell 3000 Index. The Russell 3000 Index is a broad market index like the S&P 500. Appendix I.B describes the Russell 3000 Index and compares it to the S&P 500 Index. In addition to these two broad market indices, we also use four style indices as benchmarks. To be more specific, we use separate benchmarks for four different investment styles. These style indices are the Russell 1000 Index (for Market-Oriented managers), the Russell 2000 index (for Small Cap managers), the Russell Price-Driven Index (for Price-Driven managers), and the Russell Earnings Growth Index (for Earnings Growth managers). Appendix I.B describes these indices and compares them to broad market indices. The use of several alternative indices will allow us to examine the sensitivity of pension fund manager's performance to alternative benchmarks. An estimate of the variance of the excess return on the market, $(\sigma_s)^2$, was derived from observed returns for each benchmark following the procedure of Lee and Rahman (1990).

In the empirical test, it is necessary to correct for heteroscedasticity in both the Treynor and Mazuy model and the Bhattacharya and Pfleiderer model. In the Treynor and Mazuy model, the error term will exhibit conditional heteroscedasticity because of the fund manager's attempt to time the market, even though security returns are assumed to be independent and identically distributed through time. To correct this, following Breen, Jagannathan and Ofer

(1986) and Lehmann and Modest (1987), we use heteroscedasticity-consistent standard errors proposed by White (1980), Hansen (1982), and Hsieh (1983). The significance tests reported in Section III are based on heteroscedasticity-adjusted t-statistics.

In the Bhattacharya and Pfleiderer model, the procedure discussed in Section I does not produce the most efficient estimates of the parameters since the disturbance term in equations (3) and (5) are heteroscedastic. More efficient estimates can be obtained by taking into account the heteroscedasticity of the disturbance terms. We followed a Generalized Least Squares (GLS) procedure, which makes a correction for heteroscedasticity, to obtain efficient estimates of parameters. This methodology is more fully described in Lee and Rahman (1990).

As noted in Coggin and Hunter (1991), one weakness of the Treynor and Mazuy and the Bhattacharya and Pfliederer models is that they ignore negative or inferior market timing. We modify these models to allow negative timing skill. We hypothesize that managers may exhibit negative ex post timing skill. In the Treynor and Mazuy model, this means the manager holds a smaller portion of the market portfolio when the market return is high. In the Bhattacharya and Pfleiderer model, this is indicative of a negative correlation between beta and the market return. Such results in both models could be due to the inability of managers to correctly forecast the expected return on the market portfolio. Hence these managers would forecast the market return to be high when it is actually low and vice versa. In the Treynor and Mazuy model of equation (2), a negative value of γ would be indicative of poor market timing.

For the Bhattacharya and Pfliederer model, we examine the sign of the coefficient of $(R_{m1})^2$ in equation (3). Intuitively, in the spirit of the Treynor and Mazuy model, the sign of this coefficient will be indicative of the nature of timing skill. If the estimated value of this

coefficient is negative, we designate timing skill given by ρ to be poor or inferior. This modification makes these models more realistic. A similar adjustment of the Bhattacharya and Pfleiderer model was implicitly introduced in Jagannathan and Korajczyk (1986, p. 229).

III. Empirical Results

A. Significant Selectivity and Timing Skill

Table I presents summary results from the two models. In this table and those that follow, "S&P 500" denotes results based on using the S&P 500 as the benchmark portfolio, "Russell 3000" denotes results based on using the Russell 3000 as the benchmark portfolio, and "Style Index" denotes results based on using each manager's appropriate style index as the benchmark portfolio. These results show some evidence of positive security selection skill and negative timing skill on the part of managers. The number of significant positive selectivity values exceeds the number of significant negative selectivity values for both models regardless of the benchmark used. For timing skill, the results are just the opposite. For both models, the number of significant negative timing values exceeds the number of significant positive timing values regardless of the benchmark used.

---- Insert Table I about here ----

B. Mean Values of Performance Measures

Table II presents the means of the selectivity and timing values for all managers and for the subsets of managers classified by investment style. For the entire sample (All Managers),

both models show a positive mean selectivity value for all three alternative benchmarks. These values are significant at the .05 level for two of the three benchmarks. For timing skill, the results are just the opposite. For the entire sample, both models show a negative mean timing value for all three alternative benchmarks. However, for only one of the three benchmarks (the S&P 500), the mean timing value is significant at the .05 level for both models. Hence the results using the S&P 500 Index as a benchmark contrast with the results obtained using the Russell 3000 Index and the style indices as benchmarks. As shown in Appendix I.B, the latter two indices are much more representative of the managers' investment universe (i.e., true investment opportunities) than the former and, as such, are more appropriate benchmarks than the former.

The results in Tables I and II suggest that pension fund managers are on average better stock pickers than market timers. The results that were only hinted at in Table I are now strongly confirmed in Table II. Our results relating to selection skill are consistent with those of Lee and Rahman (1990), who found some evidence of superior selection skill on the part of mutual fund managers. They also found evidence of superior market timing skill for several managers. However, it should be pointed out that Lee and Rahman (1990) ignored negative market timing skill in their model, while we allow negative market timing here. Our market timing results are consistent with those of previous studies on mutual fund performance (see Kon (1983), Chang and Lewellen (1984), Henriksson (1984), Lehmann and Modest (1988), Cumby and Glen (1990), Coggin and Hunter (1991), and Connor and Korajczyk (1991)). These studies found more evidence of negative market timing than positive. These studies also found some evidence of negative selection skill for mutual funds.

There are differences in the portfolio characteristics and investment styles among the Earnings Growth, Market-Oriented, Price-Driven, and Small Capitalization managers. It is therefore useful to examine performance measures for each investment style separately. Table II presents mean values of the performance measures for each style of manager. It also provides the aggregated rank of each group. These ranks do not vary between the models for a given benchmark. However, they do vary somewhat across benchmarks for a given model.

The period 1983-1990 was a period in which the overall stock market was up substantially. For the eight years, the Russell 3000 grew at an annualized rate of 14.17%, and the S&P 500 grew at a 15.60% rate. For the majority of this period (up until the end of 1988) the "value" investment style was favored by the market relative to other investment styles. Our analog of this style is the Price-Driven index which grew at an annualized rate of 15.53%. This compares to the "growth" investment style (represented by the Earnings Growth index) which grew at a 13.72% rate, and the Small Capitalization style (represented by the Russell 2000 index) which grew at a 7.38% rate. In Table II we see that, using the broad stock market indices as benchmarks, a negative mean selectivity value is consistently observed for the growth and small capitalization managers. This is consistent with the preference of the stock market for the period. However, if we look at the Style Index as a benchmark, we see that these managers (as well all other styles) have positive selectivity values. Thus, while we observe a positive mean selectivity value across All Managers for each benchmark, it does appear to make a difference which benchmark portfolio is used (and, perhaps, which time period) when we move to the level of investment style.

---- Insert Table II about here ----

C. Correlation of Performance Measures

To examine the sensitivity of results to benchmarks and models, we also examine the correlation of the performance measures across models and benchmarks. We use two measures of association - the Pearson correlation coefficient and the Spearman rank correlation coefficient. Tables III, IV, and V provide correlational summaries of the results presented in Tables I and II. Table III represents the correlation of a performance measure (selectivity or timing) with itself between benchmarks for a given model. All the correlations reported in the table are significant at the .0001 level. There is a very high correlation between the results based on the broad market indices - the S&P 500 Index and the Russell 3000 Index. The performance measures based on these benchmarks are somewhat less correlated with those based on style indices. These results are consistent for both models and also for both the timing and selectivity measures. Table IV presents the correlation of a performance measure (selectivity or timing) with itself between models for a given benchmark. These correlations are very high and significant at the .0001 level. The results in Tables III and IV indicate high ranking consistency among benchmarks and between models.

Finally, we present the correlation between selectivity and timing skill within a model for a given benchmark. These correlations are presented in Table V. All these correlations are significantly negative. These results indicate that good (poor) selectivity is associated with poor (good) timing ability regardless of the benchmark or model used. This implies that fund managers can not accomplish both selectivity and timing simultaneously. We will have more to say about this in Section V.B.

---- Insert Tables III, IV, V about here ----

IV. Meta-Analysis of Results

Meta-analysis is a statistical methodology for the cumulation of results across studies. The contribution of meta-analysis is to offer a statistical technique to produce direct estimates of the mean and standard deviation of population values. Thus, meta-analysis allows more statistically powerful inferences from data than are possible using more traditional disaggregated analyses. Following its early beginnings in physics and psychology, meta-analysis has recently been applied to cumulate results across studies in several other disciplines including accounting (Christie (1990) and Trotman and Wood (1991)), finance (Coggin and Hunter (1983, 1987, 1991) and Dimson and Marsh (1984)), and marketing (Farley and Lehman (1986)). Recent comprehensive texts on meta-analysis include Hedges and Olkin (1985) and Hunter and Schmidt (1990).

There are a number of "study artifacts" which can cause the results of one study to appear different or even contradictory to those of another. Among the more prominent artifacts are sampling error, error of measurement, and restriction of range on the dependent variable. These artifacts are discussed in detail in Hunter and Schmidt (1990, Chapters 2 and 3). In this paper, we focus on sampling error in the regression values for selectivity and market timing across managers. Meta-analysis has been primarily developed for correlational data. However, the time series regressions performed in our paper have identical specifications (by performance measurement model) across the sample of pension fund managers. Thus, for the purpose of meta-analysis, we can consider each of the 71 managers as a "study," cumulate the results and apply meta-analysis. Appendix II to this paper presents a brief discussion of the meta-analysis technique for regression coefficients used in this section.

Table VI presents the results of the meta-analysis of the selectivity and timing coefficients based on three benchmark portfolios and using heteroscedasticity corrected t-values. The first row of this table gives the frequency-weighted mean of the observed values for each parameter, \bar{b} ; the second row gives estimates of the standard deviation of the observed values, s_b ; the third row gives estimates of the standard deviation of the population values, s_β ; the fourth row gives estimates of the frequency-weighted average squared deviation of the observed values, s_b^2 ; the fifth row gives estimates of the variance of the population values, s_β^2 ; the sixth row gives estimates of the sampling error variance, s_e^2 ; the seventh row gives the chi-square value for the ratio of the observed variance to the sampling error variance; and the last row gives estimates of the proportion of total observed variance accounted for by sampling error, s_e^2/s_b^2 .

--- Insert Table VI about here ---

A. Selectivity

For selectivity, the mean monthly values are positive in every case but very small. However, on an annualized basis, these numbers become more meaningful. For the Bhattacharya and Pfleiderer model, the annualized mean selectivity values are .41% (S&P 500), .93% (Russell 3000), and 1.97% (Style Index). For the Treynor and Mazuy model, the annualized mean selectivity values are .51% (S&P 500), .96% (Russell 3000), and 1.99% (Style Index). Hence we see that for both models, managers do better on average relative to their own style index as compared to the broader market indices. This result is instructive, since much of the common investment wisdom implies that investment managers "can't beat the market." This result

suggests that such a comment begs an important question regarding which benchmark should be used in evaluating a manager. We remind the reader that these returns are net of investment management fees.

The chi-square values are significant at the .05 level or less for the selectivity values using all three benchmarks for both models. This implies that there is real variation (in excess of that attributable to sampling error) around the mean selectivity value in each case.

B. Timing

For market timing, the mean values are negative in each case. This result is consistent with the results of Kon (1983), Chang and Lewellen (1984), Henriksson (1984), Grinblatt and Titman (1988), Lehmann and Modest (1988), Cumby and Glen (1990), Coggin and Hunter (1991), and Connor and Korajczyk (1991) who examined mutual fund returns. Furthermore, the chi-square values are significant at the .10 level or less in each case except for the Bhattacharya and Pfleiderer model using the S&P 500 benchmark. Thus in almost every case there is evidence of real variation around the negative mean timing value.

C. The 80% Probability Intervals for Selectivity and Timing

If there were no real variation around the observed mean value, then the observed mean would be the true value for each of the 71 managers. However, in our case, there is evidence of real variation in almost every set of selectivity and market timing values. To put these results in perspective, we can look at the last row of Table VI for each model and examine the proportion of total observed variance accounted for by sampling error. For the Bhattacharya and

Pfleiderer model, the percentage of observed variance in selectivity accounted for by sampling error goes from 71% to 57% to 50% across benchmarks; while the percentage of variance in timing accounted for by sampling error goes from 95% to 81% to 68% across benchmarks. For the Treynor and Mazuy model, the percentages for selectivity go from 71% to 57% to 50% across benchmarks; while the timing percentages go from 18% to 17% to 14% across benchmarks. We should note that, as discussed in Hunter and Schmidt (1990), these percentages of variance attributable to sampling error may well contain other unaccounted for study artifacts (such as measurement error).

Assuming selectivity and market timing to be normally distributed, we can also examine the 80% probability intervals (i.e., the lower and upper 90% probability values) for the spread of the observed and population values presented in Table VII. The probability intervals in Table VII clearly show the amount of variation in both the observed and the population values for selectivity and market timing.

As noted above, there is real variation in selectivity and timing values in every case except one (i.e., timing values from the Bhattacharya and Pfleiderer model using the S&P 500 benchmark). The 80% probability intervals for selectivity are all shifted towards positive values, while the 80% probability intervals for timing are all shifted towards negative values. This result is confirmed by the significance counts for positive and negative selectivity and timing values in Table I.

Using the 80% probability intervals for the population selectivity values in Table VII, we can look at the true spread in pension manager excess returns for the two models across benchmarks. The return for the top 10% of managers is obtained by annualizing the appropriate

upper bound return in Table VII, and the return for the bottom 10% of managers is obtained by annualizing the appropriate lower bound return in Table VII. For the Bhattacharya and Pfleiderer model using the S&P 500 benchmark, the true annualized spread in returns is 4.52% (top 10% = 2.69%, bottom 10% = -1.83%); using the Russell 3000, the true spread is 5.49% (top 10% = 3.71%, bottom 10% = -1.78%); and using the style index, the true spread is 5.44% (top 10% = 4.72%, bottom 10% = -.72%). For the Tryenor and Mazuy model, the true annualized spread in returns using the S&P 500 benchmark is 5.01% (top 10% = 3.04%, bottom 10% = -1.97%); using the Russell 3000, the true spread is 5.55% (top 10% = 3.77%, bottom 10% = -1.78%); and using the style index, the true spread is 5.86% (top 10% = 4.96%, bottom 10% = -.90%). Hence there is evidence in our data that the best pension fund managers can deliver substantial risk-adjusted excess returns, no matter which model or benchmark we use. This complements the results of Grinblatt and Titman (1989a), Ippolito (1989), Lee and Rahman (1990), and Coggin and Hunter (1991) who found evidence of superior performance in their studies of mutual funds.

--- Insert Table VII about here ---

D. The Correlation between Selectivity and Timing

Looking at the last line of each panel in Table VI (s_e^2/s_b^2), we see that in each case for both models the style index benchmark results in the least amount of sampling error in the variation of the selectivity and timing values. If we treat sampling error as analogous to measurement error, then (adopting the language of classic psychometric reliability theory) the estimates of selectivity and market timing using the style index benchmark have a higher "reliability" than

the other estimates. This is consistent with our earlier observation that the style indices are more representative of the managers' true investment universes. Hunter and Schmidt (1990, pp. 115-116) show that the attenuating effect of sampling error on correlations is analogous to the attenuating effect of measurement error. They then show that observed correlations can thus be corrected for sampling error in the same way as the psychometric correction for measurement error, or unreliability, in psychometric terminology.

In the psychometric reliability model, the reliability of variable x is denoted r_{xx} and is defined as σ_T^2/σ_x^2 ; where T =true score and x =observed score. In the present context, the variables to be correlated are actually estimates of the two parameters, selectivity and market timing. If we estimate the "reliability" of each parameter as s_β^2/s_b^2 , then we can substitute into the psychometric two-sided correction for attenuation formula (Thorndike (1982)):

$$\text{corrected corr.} = \text{observed corr.} / [\sqrt{(\text{reliability of } x)} * \sqrt{(\text{reliability of } y)}] \quad (7)$$

The observed correlations between selectivity and timing were given in Table V. We can now correct the observed correlations in Table V for the effect of sampling error. Thus, for the style index benchmark, we have corrected correlation = $-.359 / [\sqrt{.500} * \sqrt{.318}] = -.90$ for the Bhattacharya and Pfleiderer model, and $-.399 / [\sqrt{.500} * \sqrt{.855}] = -.61$ for the Treynor and Mazuy model. This further confirms the results of previous studies (see Kon (1983), Henriksson (1984), Coggin and Hunter (1991), and Connor and Korajczyk (1991)).

While we can correct the observed correlations for sampling error, we cannot in any uncomplicated way correct for the possibility of a negative correlation between the two described in Jagannathan and Korajczyk (1986). They show that it is possible to observe a negative correlation between selectivity and timing in a sample of mutual funds if the common stocks held

by the funds are more/less option-like than the stocks in the market proxy. However, since our finding of a negative correlation is replicated across all benchmark portfolios in Table V, we believe it is unlikely that our observed correlations are seriously affected by this problem.

V. Discussion

A. Sensitivity of Results to Benchmarks and Models

Our general finding is that selectivity is positive and timing is negative on average across all models and benchmarks. The results in Tables III and IV indicate that the rankings of both performance measures are not very sensitive to alternative benchmarks and models in our data. However, we did observe some sensitivity to the choice of a benchmark when we divided the managers up by investment style. These results contrast with those of Lehmann and Modest (1987) and Grinblatt and Titman (1989a).

It should be pointed out that there is a problem in the Lehmann and Modest (1987) analysis. They examined selectivity in the context of a Jensen-like measure using the CAPM and APT models. Market timing and factor timing activities are not included in their analysis. Market timing was also ignored by Grinblatt and Titman (1989a). Grant (1977) explained how market timing actions will affect the results of empirical tests that focus only on selection skill. He showed that market timing ability will cause the observed regression estimate of selectivity to be downwardly biased. The results of Lee and Rahman (1990) are consistent with Grant's (1977) contention. A similar conclusion was drawn by Chang and Lewellen (1984) and Henriksson (1984). Moreover, as Jensen (1972), Admati and Ross (1985), Dybvig and Ross

(1985), and Grinblatt and Titman (1989b) have shown, the Jensen-like measure may penalize the performance of market timers.

B. Negative Correlation Between Selectivity and Timing

As discussed in Sections III and IV, we calculate a strongly negative correlation between selectivity and market timing in our data. Furthermore, this is consistent with the results of several other studies. The literature on investment management contains a number of studies documenting the negative market timing ability of mutual fund managers (see Chua and Woodward (1986) for a summary and extention of these studies). Ours is the first study we know of which documents this finding for pension fund managers. While we offer no formal model here to explain the negative correlation, we can offer some observations.

The job of equity investment management can be said to include two separate tasks: picking stocks and timing the market. As many studies have shown, each of these jobs is very difficult to do well consistently. Indeed, we show that only the best managers do well on either dimension taken separately. This has resulted in many managers opting to market to prospective clients only one of these skills. There is also much anecdotal evidence indicating that a growing number of pension plan sponsors do not believe that market timing is possible on a consistent basis, and therefore do not hire managers who attempt it. The strongly negative correlation between selectivity and timing in our data suggests that those managers who are good at selectivity are not good at timing, and those managers who are good at timing are not good at selectivity.

This intuitively makes sense, because the two investment activities are largely separate and distinct. However, recall that the general functional form of our estimating equation for selectivity and timing is the nonlinear Treynor-Mazuy model. An inspection of the standard econometric formulas quickly reveals that the sampling errors for the two coefficients in this model are negatively correlated. This clearly contributes to the negative correlation between the two. However, we note that Connor and Korajczyk (1991) also found a negative correlation between selectivity and timing using a "new version of the Henriksson-Merton model," which does not appear to suffer from this problem. This suggests that our result may not be entirely artifactual.

Finally, one needs to be somewhat concerned about the size of the timing values. At a purely statistical level, one can assess the significance of the timing values by looking at the t-tests. However, in the Treynor-Mazuy model the impact of timing on portfolio return is, in effect, measured by multiplying a rather small decimal fraction, γ , by a squared decimal fraction, $(R_{mt})^2$. Thus, at the level of actual portfolio returns, there is a relatively small reward/penalty to this activity in our data. Further research in the the area of the measurement and assessment of market timing would help clarify this issue.

C. Survivorship Bias

The issue of survivorship bias is well known in studies of investment performance. A recent study by Brown, Goetzmann, Ibbotson and Ross (1991) highlights this issue with regard to performance measurement. The basic issue here is as follows. Our study includes 71 pension managers with complete data from 1983 to 1990. Hence, any manager who may have

disappeared through merger or poor performance is not included in our data. To the extent that our sample underrepresents such managers, our results are biased in favor of more successful managers. We do not know the true extent of this bias in our results, but the results in Grinblatt and Titman (1989a) suggest that it is not large.

VI. Summary and Conclusion

This paper presents an empirical examination of the selectivity and timing performance of a sample of U.S. equity pension fund managers. Our major findings are as follows. The results on selectivity and timing are only mildly sensitive to the benchmark portfolio or estimation model used. Moreover, regardless of the choice of benchmark portfolio or estimation model, the selectivity measure is positive on average; and the timing measure is negative on average. However, selectivity does appear to be somewhat sensitive to the choice of a benchmark (and, possibly, the time period) when managers are classified by investment style. In almost every case, meta-analysis revealed some real variation (in excess of that attributable to sampling error) around the mean values for each measure. An examination of the 80% probability intervals for selectivity revealed that the best equity pension fund managers can deliver substantial risk-adjusted excess returns. Consistent with previous studies of mutual fund performance, we also found a negative correlation between selectivity and timing.

Much work remains to be done in this area. While active equity managers are currently losing ground to passively managed index funds, actively managed equities still represent the largest fraction of the equity component of corporate pension funds. We still do not know why some active managers are able to provide substantial risk-adjusted performance, while most

cannot. Identifying the characteristics of successful money managers should be one focus of future research. While there are some interesting hypotheses, we still do not know why there is a consistently negative correlation between the selectivity and timing ability of active equity managers. This is another fertile area for study.

Appendix I

This appendix is based on Haughton and Christopherson (1989).

A. Style Descriptions

1. Earnings Growth: Earnings Growth managers focus predominantly on earnings and revenue growth and attempt to identify companies with above-average growth prospects. In general, two basic categories of securities are owned by Earnings Growth managers - (a) companies with consistent above-average (historical and prospective) profitability and growth, and (b) companies expected to generate above-average near-term earnings momentum based upon company, industry, or economic factors.
2. Market-Oriented: Market-Oriented managers are broadly diversified managers who participate in all sectors of the market. The portfolios of these managers may either be well diversified, or take meaningful sector/factor bets relative to the market toward both growth and value over time. Market-Oriented managers typically are willing to consider companies representative of the broad market when seeking investment opportunities.
3. Price-Driven: Price-Driven managers focus on the price and value characteristics of a security in the selection process. These managers buy stocks from the low price portion of the market, and are sometimes called value or defensive/yield managers. In general, these managers focus on securities with low valuations relative to the broad market.

4. Small Capitalization: Small Capitalization managers focus on small capitalization stocks. These companies may be unseasoned and rapidly growing but sometimes are simply small businesses with long histories. Typical characteristics of small capitalization portfolios are below-market dividend yields, above-market betas, and high residual risk relative to broad market indices.

B. Description of Russell Indices

Benchmarks for Aggregate Portfolios

Russell 3000 Index: The Russell 3000 Index includes the top 3000 U.S. companies ranked by capitalization. Haughton and Christopherson (1989) discussed two reasons for choosing the Russell 3000 Index over the S&P 500 Index.

(1) The S&P 500 spans only 75% of the investable U.S. equity market. As such, it has a large capitalization bias but, within large cap stocks, it excludes some large companies. It also includes non-U.S. companies, so it is not strictly a U.S. equity market benchmark. There is no adjustment in the index for cross-ownership of shares, resulting in the overweighting of certain companies. Since it covers only 500 companies, it does not reflect many of the long-term bets managers take away from the index.

(2) The Russell 3000 covers 98% of the investable U.S. equity market. It weights all market sectors according to their investment opportunities, and is confined to U.S. companies and hence has no foreign exposure. It is adjusted for cross-ownership, thereby reflecting true investment opportunities; and spans nearly all of the stocks in which a manager is likely to invest. Hence, the index is relatively unbiased.

Style Indices

Broad market benchmarks like the S&P 500 and the Russell 3000 are suitable for evaluating pension managers who use the whole market as a base. Many U.S. equity pension managers specialize in subsets of the market. As such, a finer set of performance benchmarks that more closely match the investment styles of individual managers is needed to ensure identification of elements attributable to investment styles. The Frank Russell Company maintains four style indices - one for each investment style. The key fundamental characteristics of each style index are similar to the equity profile of a typical manager of that style. This indicates that the subuniverse of stocks that comprise the style indices contains the type of stocks from which each style of managers would normally choose; i.e., they constitute rough "normal" portfolios. These style benchmarks are much more representative of the specialized managers' selection universes than the broad market and hence should provide better tools for performance evaluation. These style indices are:

1. Russell 1000 Index: The Russell 1000 is the benchmark recommended for Market-Oriented style managers. It is composed of the top 1000 stocks in the Russell 3000 Index ranked by capitalization. Hence, it focuses on the broad-based large cap segment of the market and encompasses about 90% of all the equity opportunities in the U.S. equity market.
2. Russell 2000 Index: The Russell 2000 is the small cap benchmark and is useful for evaluating small capitalization managers. It is composed of the smallest 2000 stocks in the Russell 3000 Index ranked by capitalization. Of the 10% of the total U.S. equity market comprised of small stocks, the Russell 2000 Index covers about 8%.
3. Earnings Growth Index: Earnings Growth Index is an index for Earnings Growth style managers, and is composed of those securities in the Russell 1000 Index that have above-average growth prospects. Securities in this style index are weighted according to their total capitalization.
4. Price Driven Index: Price Driven Index is an index for Price Driven managers. It is a capitalization-weighted index composed of those securities in the Russell 1000 Index that have low valuations relative to the broad market. "Low valuation" is defined by examining financial ratios such as the P/E ratio, dividend yield, the price/book ratio, and the price/sales ratio.

Appendix II

The Meta-Analysis of Regression Values

A. Theoretical Meta-Analysis Parameters

This appendix is taken from a more detailed presentation given in Coggin and Hunter (1991). Meta-analysis was developed as a methodology to cumulate results across studies. In this appendix, we will use the words "study," "manager," and "portfolio" interchangeably. We initially assume that the number of managers to be analyzed is large enough that we can ignore sampling error due to a finite number of managers, and concentrate on sampling error in regression estimates for individual managers. We also assume that the specification of each regression equation is identical across managers. We denote observed regression values as b , population values as β , and sampling error as e . Thus:

$$e = b - \beta \text{ or } b = \beta + e \quad (\text{A-1})$$

The average observed value is:

$$\bar{b} = \bar{\beta} + \bar{e} \quad (\text{A-2})$$

Across a large number of managers, the average error, \bar{e} , will be zero; thus $\bar{b} = \bar{\beta}$.

Since we are comparing the portfolios of pension fund managers, we denote each manager by the subscript i . Then:

$$b_i = \beta_i + e_i \quad (\text{A-3})$$

Across portfolios, β and e will be uncorrelated, so that the variance of observed values, σ_b^2 , will be larger than the variance of population values, σ_β^2 , by the amount of sampling error, σ_e^2 :

$$\sigma_b^2 = \sigma_\beta^2 + \sigma_e^2 \quad (\text{A-4})$$

From equation (A-4), the variance of the population regression values can be written as:

$$\sigma_{\beta}^2 = \sigma_b^2 - \sigma_e^2 \quad (A-5)$$

The key to meta-analysis is the fact that the sampling error variance, σ_e^2 , can be computed using known statistical theory. Thus equation (A-5) becomes a formula to compute the population variance, σ_{β}^2 .

B. Estimating Meta-Analysis Parameters

In the previous section, we assume that the number of studies to be cumulated is large. Specifically, this implies that the observed variance of the sampling errors would equal the theoretical sampling error variance. If the number of studies is small, then the observed variance of the sampling errors will differ by chance from the theoretical sampling error variance. Hence we use the notation "s²" for the estimated variances below.

If a population value is assumed be constant across studies, Hunter and Schmidt (1990) show that the best estimate of that value is its frequency-weighted average:

$$\bar{b} = \Sigma[N_i b_i] / \Sigma N_i \quad (A-6)$$

where b_i is the observed value in study i and N_i is the number of observations in study i . The corresponding observed variance estimate across studies is the frequency-weighted average squared deviation:

$$s_b^2 = \Sigma[N_i(b_i - \bar{b})^2] / \Sigma N_i \quad (A-7)$$

The observed variance estimate, s_b^2 , is a confounding of two sources of variation: variation in population values (if any) and variation in observed values due to sampling error. Thus an estimate of the variation in population values can only be obtained by correcting the observed variance estimate, s_b^2 , for sampling error. Hunter and Schmidt (1990) show that sampling error

across studies behaves like error of measurement, and the resulting formulas are comparable to the standard formulas in classic psychometric measurement theory or reliability theory.

From classic psychometric theory (Thorndike (1982)), we have:

$$\text{Observed value} = \text{true value} + \text{error of measurement} \quad (\text{A-8})$$

where the true value and error of measurement are uncorrelated. Hence:

$$\text{Observed variance} = \text{true variance} + \text{error variance} \quad (\text{A-9})$$

In meta-analysis, it is similarly true that the population regression values, β_i , and the sampling error, e_i , are uncorrelated across studies. Therefore we can write:

$$\text{Observed variance} = \text{population variance} + \text{sampling error variance} \quad (\text{A-10})$$

$$s_b^2 = s_\beta^2 + s_e^2 \quad (\text{A-11})$$

The observed variance estimate, s_b^2 , is the frequency-weighted average squared deviation defined above. The sampling error variance estimate required by meta-analysis is then:

$$s_e^2 = \Sigma [N_i(\text{standard error } b_i)^2] / \Sigma N_i \quad (\text{A-12})$$

The population variance (sometimes called the "corrected variance") can thus be estimated as:

$$s_\beta^2 = s_b^2 - s_e^2 \quad (\text{A-13})$$

Equation (A-13) is the fundamental estimating equation for the theoretical values in equation (A-5).

The population variance estimate, s_β^2 , can be positive, negative or zero. If it is negative or zero, the inference is that there is no variation in observed values that cannot be attributed to sampling error. That is, all variance in observed values is artifactual. If the corrected variance across studies is positive, it may still be trivial in size.

C. A Significance Test for Real Variation Across Studies

The hypothesis that there is no real variation in observed values has a statistical test. The ratio of the observed variance estimate to the sampling error variance estimate has a chi-square distribution with $k-1$ degrees of freedom:

$$\chi^2 = ks_b^2/s_e^2 \quad (A-14)$$

where k = number of studies.

This statistic can be used as a formal test of no variation; although if k is large, it has high statistical power and may reject the null hypothesis given even a trivial amount of real variation (Hedges and Olkin (1985), Cohen (1988), and Hunter and Schmidt (1990)). Thus if the chi-square value is not significant, there is strong evidence that there is no real variation across studies. However, if the k studies are not independent, then the power of the chi-square test is reduced as discussed in the next section.

D. Independence

Given a set of regression estimates, there is a corresponding set of sampling errors. In the preceding discussion, it was assumed that the variance of sampling errors across the studies would itself differ only by sampling error from the hypothetical error variance across independent replications. This is true for most applications of meta-analysis and follows immediately from the independence of the estimates across studies. However, this is not always true.

In this study the impact of the market proxy is controlled. However, the portfolios of two equity pension fund managers may overlap. Hence the securities the two portfolios have in common will contribute their particular returns to both portfolio return sequences. The residuals of those securities will thus contribute to the residuals of the two portfolios. This means that the two portfolios will not have residual time series that are entirely independent. Thus the sampling errors for the two portfolio regressions will also be nonindependent and positively correlated.

Consider the set of sampling errors for two portfolios. If the correlation between errors is r , then the variance across portfolios will not be $\text{Var}(e)$, but rather the product $[(1-r)\text{Var}(e)]$. The corresponding formulas for meta-analysis are:

$$\text{Var}(b) = \text{Var}(\beta) + (1-r)\text{Var}(e) \quad (\text{A-15})$$

$$\text{Var}(\beta) = \text{Var}(b) - (1-r)\text{Var}(e) \quad (\text{A-16})$$

$$\text{Var}(\beta) = [\text{Var}(b) - \text{Var}(e)] + r \text{Var}(e) \quad (\text{A-17})$$

Thus, traditional meta-analysis formulas will underestimate the variance of β . In particular, the variances for timing and selectivity estimated in this paper are too low by some amount. The adjusted formula for chi-square would thus be:

$$\chi^2 = k \text{Var}(b)/[(1-r)\text{Var}(e)] \quad (\text{A-18})$$

$$\chi^2 = [1/(1-r)][k \text{Var}(b)/\text{Var}(e)] \quad (\text{A-19})$$

Hence, the traditional test statistic for homogeneity of regression values given earlier in equation (A-14) would be an underestimate and thus would have somewhat lower than optimal power to detect departures from homogeneity. Therefore the traditional chi-square test would be a "conservative" test for heterogeneity.

The size of the correlation between residuals for two portfolios depends on the extent of overlap between the portfolios. Most equity pension managers invest in many securities in an effort to diversify risk. Moreover, pension fund managers are independent of each other and typically differ significantly in management style, asset allocation, and rebalancing of portfolios. Thus, our working hypothesis is that the overlap is small in magnitude and hence the correlation r is small enough to make little difference in our analysis. While we believe this hypothesis to be reasonable, we know of no study of portfolio overlap which we could consult to check its validity. Data on individual securities held in the managers' portfolios were not available to us for this study.

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Table I

Summary Statistics for Pension Manager Performance (1983-90)

This table presents summary statistics for the 71 managers for the entire sample period. The number of positive and negative selectivity and timing values are given for each model for each benchmark portfolio. Only those values which are significant at the .05 level or less are counted. The numbers in parentheses indicate the percent of the total sample.

	<u>Russell 3000</u>		<u>Style Index</u>		<u>S&P 500</u>	
	<u>Positive</u>	<u>Negative</u>	<u>Positive</u>	<u>Negative</u>	<u>Positive</u>	<u>Negative</u>
<u>Bhattacharya and Pfeiderer Model</u>						
Selectivity	10(14.1%)	1(1.4%)	13(18.3%)	0(0%)	6(8.5%)	1(1.4%)
Timing	2(2.8%)	4(5.6%)	3(4.2%)	5(7.0%)	1(1.4%)	6(8.5%)
<u>Treynor and Mazuy Model</u>						
Selectivity	9(12.7%)	2(2.8%)	13(18.3%)	0(0%)	6(8.5%)	1(1.4%)
Timing	12(16.9%)	19(26.8%)	12(16.9%)	14(19.7%)	5(7.1%)	21(29.6%)

Table II

Mean Values of Performance Measures Across Models and Benchmarks

This table presents the mean values of the selectivity and timing values across models and benchmarks for the entire sample period. The numbers in parentheses indicate the rank among investment styles for each measure.

	<u>Russell 3000</u>		<u>Style Index</u>		<u>S&P 500</u>	
	<u>Selectivity</u>	<u>Timing</u>	<u>Selectivity</u>	<u>Timing</u>	<u>Selectivity</u>	<u>Timing</u>
<u>Bhattacharya and Pfleiderer Model</u>						
All Managers	.0008**	-.0092	.0016**	-.0100	.0003	-.0470**
Earnings Growth	-.0003 (3)	.0538** (1)	.0007* (4)	.0217 (2)	-.0008* (4)	.0072 (1)
Market Oriented	.0022** (1)	.0012 (2)	.0020** (2)	-.0274 (3)	.0017** (1)	-.0451 (2)
Price Driven	.0015** (2)	-.0234 (3)	.0009* (3)	-.0843** (4)	.0009* (2)	-.0539** (3)
Small Capitalization	-.0005 (4)	-.0765** (4)	.0031** (1)	.0586* (1)	-.0007 (3)	-.1024** (4)
<u>Treynor and Mazuy Model</u>						
All Managers	.0008**	-.0828	.0016**	-.0706	.0004	-.2799**
Earnings Growth	-.0003 (3)	.2014** (1)	.0008* (4)	-.0011 (2)	-.0008* (4)	.0108 (1)
Market Oriented	.0021** (1)	-.0278 (2)	.0019** (2)	-.1261 (3)	.0017** (1)	-.1799 (2)
Price Driven	.0016** (2)	-.0877 (3)	.0009* (3)	-.3286** (4)	.0011** (2)	-.2293* (3)
Small Capitalization	-.0004 (4)	-.4625** (4)	.0032** (1)	.2074* (1)	-.0004 (3)	-.7828** (4)

** Significant at the .05 level
* Significant at the .10 level

Table III
Correlations of a Performance Measure Between Benchmarks*

Each model was estimated for all managers for the entire period using each of the three benchmark portfolios. Panel A presents the Pearson and Spearman correlations between selectivity values for each pair of benchmark portfolios for each model. Panel B presents the Pearson and Spearman correlations between timing values for each pair of benchmark portfolios for each model.

Panel A: Selectivity

	Style Index		S&P 500	
	Pearson	Spearman	Pearson	Spearman
<u>Bhattacharya & Pfleiderer Model</u>				
Russell 3000	.806	.744	.997	.994
Style Index			.832	.761
<u>Treynor and Mazuy Model</u>				
Russell 3000	.804	.734	.996	.995
Style Index			.839	.764

Panel B: Timing

	Style Index		S&P 500	
	Pearson	Spearman	Pearson	Spearman
<u>Bhattacharya & Pfleiderer Model</u>				
Russell 3000	.765	.727	.982	.977
Style Index			.777	.739
<u>Treynor and Mazuy Model</u>				
Russell 3000	.775	.704	.992	.984
Style Index			.721	.627

*All correlations are significant at the .0001 level

Table IV
Correlation of a Performance Measure Between Models*

Each model was estimated for all managers for the entire period using each of the three benchmark portfolios. This table presents the Pearson and Spearman correlations between selectivity values for each model for each benchmark, and the Pearson and Spearman correlations between timing values for each model for each benchmark.

<u>Benchmark</u>	<u>Selectivity</u>		<u>Timing</u>	
	<u>Pearson</u>	<u>Spearman</u>	<u>Pearson</u>	<u>Spearman</u>
Russell 3000	.992	.988	.901	.923
Style Index	.991	.990	.835	.930
S&P 500	.990	.985	.866	.894

*All correlations are significant at the .0001 level

Table V
Correlation Between Selectivity and Timing

Each model was estimated for all managers for the entire period using each of the three benchmark portfolios. This table presents the Pearson and Spearman correlations between the selectivity and timing values for each model for each benchmark.

<u>Benchmark</u>	<u>Bhattacharya and Pfleiderer Model</u>		<u>Treynor and Mazuy Model</u>	
	<u>Pearson</u>	<u>Spearman</u>	<u>Pearson</u>	<u>Spearman</u>
Russell 3000	-.447	-.488	-.485	-.427 ^a
Style Index	-.359 ^d	-.315 ^c	-.399 ^b	-.359 ^d
S&P 500	-.487	-.504	-.467	-.387 ^c

^a significant at the .0002 level

^b significant at the .0006 level

^c significant at the .0008 level

^d significant at the .0021 level

^e significant at the .0075 level

All other correlations are significant at the .0001 level

Table VI

Meta-Analysis Results

This table presents the meta-analysis results for the selectivity and timing values based on the three benchmark portfolios and using heteroscedasticity-corrected t-values, for the entire period (N=71 managers).

Panel A: Bhattacharya and Pfleiderer Model

	Selectivity			Timing		
	<u>S&P 500</u>	<u>Russell 3000</u>	<u>Style Index</u>	<u>S&P 500</u>	<u>Russell 3000</u>	<u>Style Index</u>
\bar{b}	.000339	.000769	.001624	-.046979	-.009194	-.010003
s_b	.002646	.002646	.002450	.105010	.114070	.123984
s_{β}	.001467	.001773	.001740	.022942	.050224	.069973
s_e^2	.000007	.000007	.000006	.011027	.013012	.015372
s_{β}^2	.000002	.000003	.000003	.000526	.002523	.004896
s_e^2	.000005	.000004	.000003	.010501	.010489	.010476
χ^2 (df=70)	100.61**	124.82**	135.43**	74.56	88.07*	104.18**
s_e^2/s_b^2	.7143	.5714	.5000	.9523	.8061	.6815

Panel B: Treynor and Mazuy Model

	Selectivity			Timing		
	<u>S&P 500</u>	<u>Russell 3000</u>	<u>Style Index</u>	<u>S&P 500</u>	<u>Russell 3000</u>	<u>Style Index</u>
\bar{b}	.000422	.000796	.001645	-.279925	-.082756	-.070593
s_b	.002646	.002646	.002450	.635032	.598273	.593544
s_{β}	.001625	.001793	.001871	.573466	.545419	.548967
s_e^2	.000007	.000007	.000006	.403266	.357931	.352295
s_{β}^2	.000002	.000003	.000003	.328863	.297482	.301365
s_e^2	.000005	.000004	.000003	.074403	.060449	.050930
χ^2 (df=70)	111.83**	128.70**	153.41**	384.82**	420.41**	491.12**
s_e^2/s_b^2	.7143	.5714	.5000	.1845	.1689	.1446

** Significant at the .05 level or less.

* Significant at the .10 level.

Table VII

80% Probability Intervals for Observed and Population Selectivity and Market Timing Values

This table presents the 80% probability intervals for the observed and population values of selectivity and market timing using all managers for the entire period. The observed values are bounded by $b \pm 1.28(s_b)$, and the population values are bounded by $b \pm 1.28(s_{\beta})$.

Panel A: Bhattacharya and Pfleiderer Model

Benchmark	Observed Values				Population Values			
	Selectivity		Market Timing		Selectivity		Market Timing	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
S&P 500	-.003121	.003800	-.181391	.087434	-.001538	.002217	-.076345	-.017613
Russell 3000	-.002687	.004255	-.155203	.136814	-.001500	.003038	-.073481	.055092
Style Index	-.001606	.004854	-.168703	.148697	-.000604	.003852	-.099569	.079563

Panel B: Treynor and Mazuy Model

Benchmark	Observed Values				Population Values			
	Selectivity		Market Timing		Selectivity		Market Timing	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
S&P 500	-.003019	.003864	-.1092766	.532916	-.001657	.002502	-.1013962	.454111
Russell 3000	-.002632	.004223	-.848546	.683034	-.001499	.003091	-.780893	.615381
Style Index	-.001622	.004912	-.830330	.689144	-.000750	.004040	-.773271	.632085

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